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Operating Instructions
Acton Research Corporation
SpectraPro-2500i



0.500 Meter Focal Length Triple Grating Imaging
Monochromator / Spectrograph

Acton Research Corporation SpectraPro-2500i Operating Instructions

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I: Brief Introduction and SpectraPro-2500i Description

Brief Introduction:

This instruction manual is intended to assist you in set-up and operation of your new SpectraPro-2500i monochromator/spectrograph. Even if you are an experienced user of spectroscopic equipment, we suggest that you follow the manual (at least initially) to insure proper setup and operation. If you have any questions about the information contained in this manual, please feel free to contact the ARC customer service department.

SpectraPro-2500i Description:

The SpectraPro-2500i is a 500mm focal length monochromator/spectrograph. It features an astigmatism - corrected optical system, triple indexable gratings and triple grating turret. The SpectraPro-2500i includes a direct digital grating scan mechanism with full wavelength scanning capabilities, plus built-in RS232 and USB computer interfaces, for use with the supplied Monochromator Control Software.

II: SpectraPro-2500i Specifications

NOTE: Each SpectraPro-2500i is operated for at least 15 minutes prior to calibration to insure optimum stability. End users should follow this practice if their application calls for optimum stability & reproducibility.

Every SpectraPro-2500i monochromator or spectrograph includes a triple grating turret for 1, 2, or 3 gratings, system, 32-bit microprocessor controlled scanning, built-in RS232 and USB interfaces, and micrometer controlled entrance slit.

Specifications (1200g/mm Grating)

Focal length: 500mm

Aperture Ratio: f/6.5 (68x68mm gratings)

Optical Design: Imaging Czerny-Turner with original polished aspheric mirrors (optional second entrance slit available)

Optical Paths: 90° standard, 180° and multi-port optional

Scan Range: 0 to 1400nm mechanical range

Operating Range: 185nm to the far infrared with available gratings and accessories

Resolution: 0.05nm at 435.8nm

Dispersion: 1.7nm/mm (nominal)

Accuracy: ±0.2nm

Repeatability: ±0.05nm

Drive Step Size: 0.0025nm (nominal)

Focal Plane Size: 27mm wide x 14mm high

CCD Focus Arrangement: Exclusive o-ring sealed sliding tube with unique 3-point focus stop/fine focus adjustment mechanism.

Detector Coverage: ~42.5nm across a 1.0" wide focal plane (~85nm: 600g/mm grating)

Standard Slits: Micrometer adjustable from 10µm to 3mm wide. Slit heights: 4 & 14mm

Grating Mount: Triple grating turret for 1, 2, or 3 gratings.

Interchangeable Grating Turrets: Optional
Grating Change Time: Less than 20 seconds

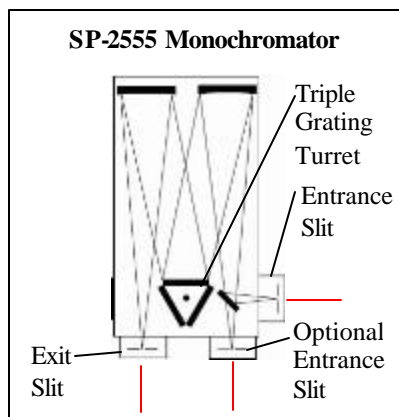
Grating Drive System: 32-bit microprocessor controlled direct digital scanning (DDS) system.

Scan Linearity: The SpectraPro-2500 scans linear with respect to wavelength

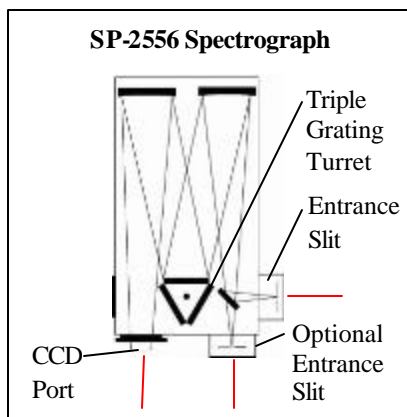
Size: 21" long (534mm)
11" wide (280mm)
8" high (203mm)
4.875" (123.8mm) optical axis height

Weight: 40 lbs (18kg)

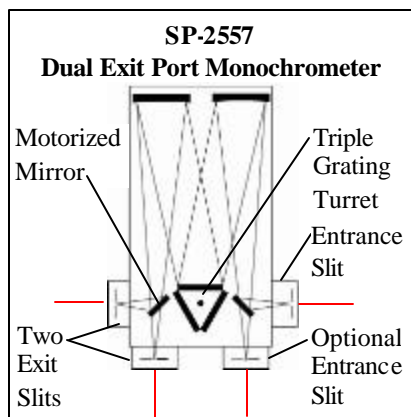
Tested and conforms to **European CE Standards**



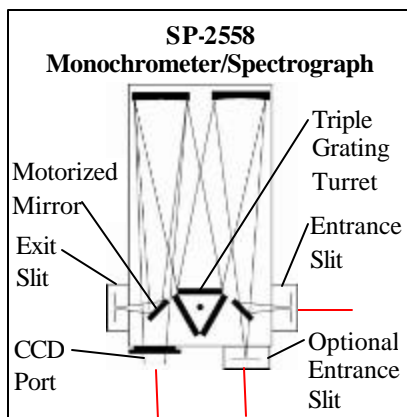
Includes a 90° optical path, and micrometer adjustable entrance and exit slits.



Includes a 90° optical path, large 14mm X 27mm focal plane, plus sliding tube CCD adapter with exclusive focus-stop.



Includes micrometer controlled dual exit slits (90° & 180°), and motorized motor for rapid, computer controlled exit slit selection.



Includes dual exit ports; one exit slit and one sliding CCD adapter with motorized mirror for rapid, computer controlled exit port selection.

III. SpectraPro-2500i Setup

Section III-A: Unpacking and Inspection

Carefully unpack and examine the SpectraPro-2500i and any accessories purchased.

Note: **Report any damage immediately to the carrier and to Acton Research Corporation, and save all packing material.**

Section III-B: Connecting the SpectraPro-2500i Monochromator/Spectrograph to the Computer or Optional Model 500-749 Remote Scan Controller

The SpectraPro-2500i is designed for operation by computer using RS232 or USB, or by using the optional Model 500-749 Remote Scan Controller. Either method of control enables wavelength scanning at a pre-set linear scan rate, change of scanning speeds, grating selection, rapid GOTO wavelength positioning, change of grating turrets if available, and “jog” wavelength positioning. Figure below shows the cable connections necessary for operation from a computer through the COM ports or with USB. Refer to the SpectraPro Monochromator Control Software for Windows for operation with a computer.

Controlling the SpectraPro with Monochromator Control Software:

The Monochromator Control Software is normally installed in the directory C:\Program Files\SpectraPro. This directory contains subdirectories Bin and Data. The Bin directory contains the executable code. There will normally be a SpectraPro icon on the desktop which can be used for starting the software. If this icon is not on the desktop go to the SpectraPro Bin directory and start the software. When the Monochromator Control software loads, there is a main screen with selections for both operating the monochromator and various setup functions. Click on the Operation box and a screen will come up which allows for basic control of the monochromator wavelength. All functions of this software are described in the Monochromator Control Software manual supplied on the Monochromator Control Software install CD.

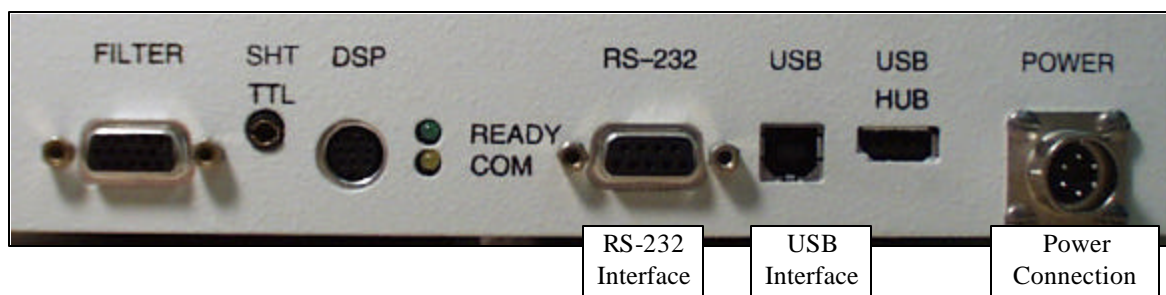
Control of the SP-2500i with User Generated Software or LabVIEW:

The Monochromator Control Software install disk contains a folder named SpectraPro_SDK. This folder contains dll's with example code in Delphi, Visual Basic, C++ and LabVIEW and well as a folder with examples for use of the COM interface.

Control of the SP-2500i Monochromator at the Command Level:

Although it requires more programming on the user's part, the monochromator can also be controlled with direct commands through its USB 1.1 port or RS-232 port. This operation is described in Section IV.

**SpectraPro-2500i Cable Connections:
Optional 500-749 Remote Scan Controller, RS232, or USB**



**Details of the RS-232, USB, and Power
Connections on the
SpectraPro-2500**

Section III-C: Cables and Connections for SpectraPro-2500i

The following computer cables are supplied with the SP-2500i:

CC-499-2 IBM AT or compatible 9 pin female (DB9S) connector to 9 pin male connector (DB9P).
3650-USB-06 USB Cable Type A to Type B.

If neither of these cables are compatible with your system, consult ARC for a custom cable. If you have facilities for constructing a custom cable, use the RS232 pin arrangement shown in Table 1. See also Appendix B.

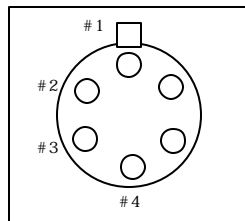
Table 1: RS232 Computer Interface Pin Arrangement:

pin #	description
1	open
2	RD data from SP-2500i to computer
3	TD data from computer to SP-2500i
4	open
5	ground
6	open
7	RTS
8	CTS
9	open

A terminal or RS232 computer port must be set up as follows: 9600 baud, 8 data bits, no parity, 1 start bit, 1 stop bit.

Table 2: Power Input Pin Arrangement:

PIN#	DESCRIPTION
1	+5V
2	GND
3	GND
4	+24V



Section III-D: Mounting Accessories to the SpectraPro-2500i Slit Assemblies

All ARC accessories come with their own set of instructions for proper mounting and operation. The instructions below are only general information. Please refer to the individual instructions for detailed information.

Accessories: The full range of ARC SpectraPro accessories mount directly to the SpectraPro-2500i slit assemblies. A drawing of the standard slit assemblies can be found in the Appendices Section to assist you in mounting accessories. To mount an accessory to the slit, the general procedure is as follows:

1. Place the accessory directly against the face of the slit body. Light sources normally mount on the entrance slit, detectors on the exit slit. Other accessories such as fiber bundles normally mount on the entrance slit, but are also compatible with the exit slit.
2. Using four (4) 8-32 screws normally provided with the accessory, secure the accessory to the slit body.

Light sources fitted with light collection/focusing optics are normally factory aligned to the standard slit.

Note: In some instances with light sources, there is limited access to the bottom two screw holes. In this case ARC provides special slotted holes in the light source housing to facilitate mounting of the source to the slit.

Section III-E: Detector Mounting Instructions: Mounting Focal Plane Detectors to the SpectraPro-2500i Spectrograph

The standard mounting flange for CCDs and diode arrays accommodates detectors with two different bolt circles. There are three (3) equally spaced #10-32 tapped holes on a 3.60" bolt circle, and three (3) equally spaced holes on a 3.88" bolt circle designed to accept #10-32 button head screws. A baffle is mounted in the array detector mounting flange to define the focal plane area. This baffle has two sets of mounting holes 90 degrees apart which permit the mounting to be rotated 90 degrees to accept different array detectors.

To mount an array detector to the SpectraPro-2500i, use the following procedure:

1. The array detector mounting flange has a sliding tube, which fits inside the front plate of the SpectraPro-2500i.

NOTE: At this point it is very important to check the focal plane distance of the array detector. This is the distance from the front mounting surface of the array detector to the actual CCD or diode array element. Because array detector focal distances vary, the correct distance is crucial in order to determine if a spacer is required for proper focus. This spacer is provided with spectrographs. If the detector focal plane distance falls between .67" and 1.00", then no spacer is required.

2. Using a 1/8" allen wrench, loosen the two (2) set screws located at the top and side of the front plate. Gently slide the array detector mounting flange all the way out of the SpectraPro-2500i housing. Make sure that the sliding tube and o-ring are kept clean.
3. Remove the shipping cover from the sliding tube, and the spacer if not required.
4. Position the array detector mounting flange against the array detector, and match the hole patterns. When correctly positioned, the baffle aperture orientation should match the detector array orientation. If it does not align properly, contact ARC.
5. Fasten the array detector mounting flange to the detector, then carefully slide this assembly back into the SpectraPro-2500i housing.
6. Tighten the #10-32 set screw on the top of the front plate first, and then tighten the one on the side.

Section III-F: Slit Width Adjustments in the Model 716 Bilateral Slits

The slit width of each bilateral slit assembly (716 type) is adjustable from 0.010 millimeters to 3 millimeters (10 to 3,000 μm) by a micrometer knob located on the top of the slit housing. The micrometer knob is graduated in 0.010 millimeter (10 μm) increments.

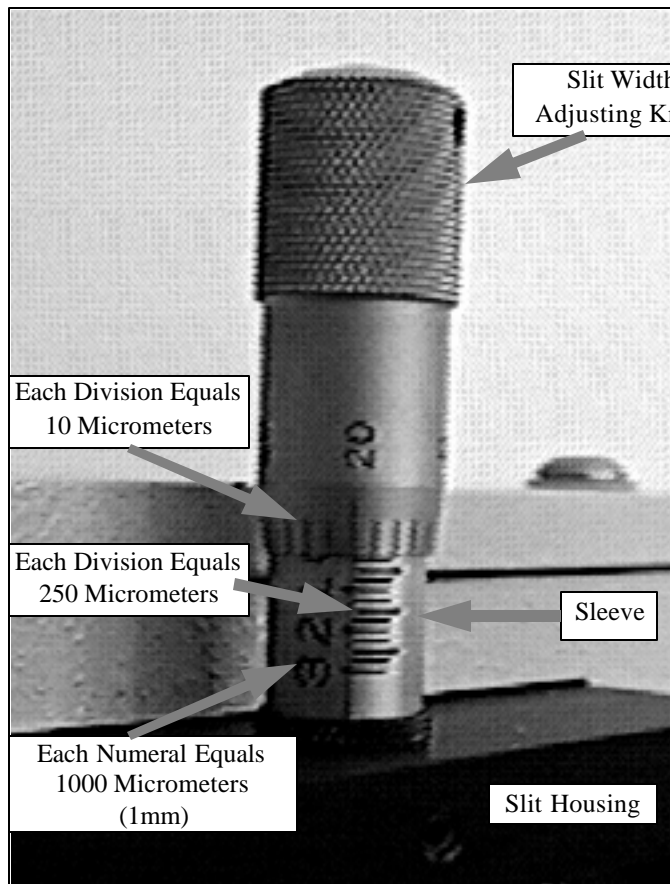
Each clockwise revolution of the micrometer knob increases the slit width 0.25 millimeters (250 μm). For maximum reproducibility, the slit width should be set in a clockwise direction (increasing slit widths) each time it is changed. Refer to the drawing below.

The micrometer knob should not be rotated below a reading of 0.00 or above 3.00. A micrometer setting of less than 0.010 millimeters (10 μm) should not be used, because a stop is provided to prevent the slit jaws from contacting each other.

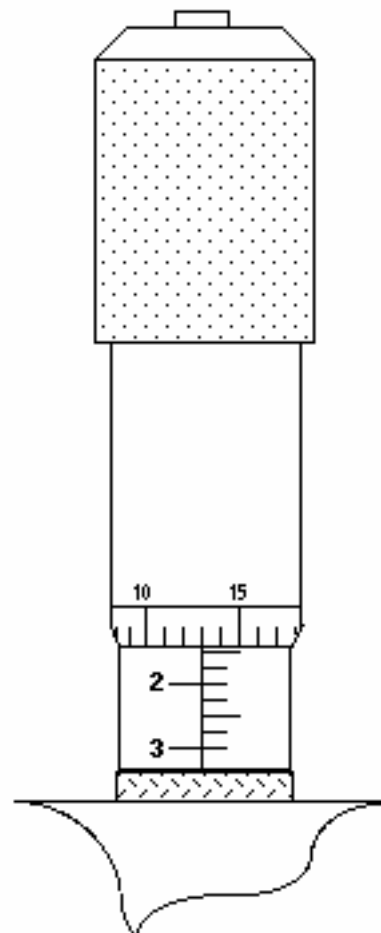
Note: Damage May Be Done If Slit Jaws Are Opened Wider Than 3.0mm.

Slit Width Micrometer Settings

**Slit Width Adjustable from
10 Micrometers to
3000 Micrometers (3mm)**



**Slit Width Setting:
200 Micrometers (0.200mm)**



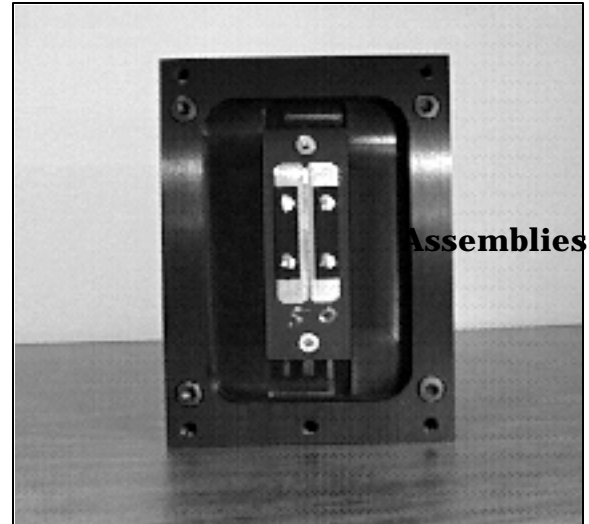
**Slit Width Setting:
1380 Micrometers (1.38mm)**

Section III-F Continued: Interchanging Fixed Width Slit Plates in the Model 715 Fixed Slit Assemblies:

If your SpectraPro was purchased with the Model 715 type fixed slit assemblies, the following procedure should be followed in order to change slit widths. First, at least one additional fixed slit plate, Model 715-4-XX or 715-14-XX, must be available to permit changing widths in the 715 type slit assemblies.

Changing Fixed Slit Plates in the 715-1 and 715-2 Assemblies:

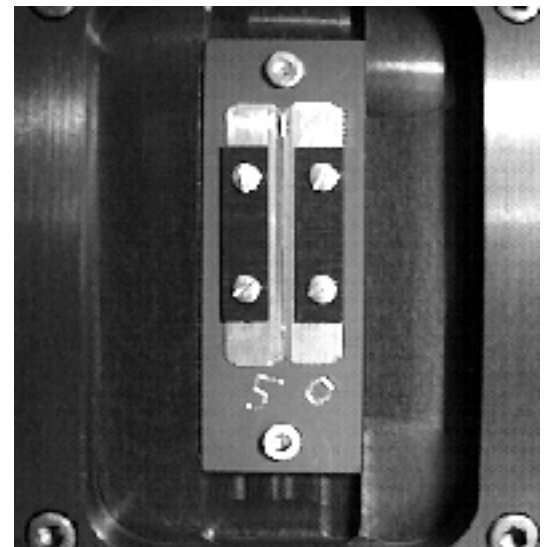
1. Remove any accessories from the slit body.
2. Using an allen wrench, loosen the two slit plate screws which hold the slit plate to the slit body. Remove the slit plate without contacting the slit blades. Store the removed slit in a clean, dry area.



**Standard Model 715 Fixed Slit Assembly
Note Optical Axis Position**

Note: Align the new slit plate to the SpectraPro optical axis by orienting it so that the slit width label is upright and readable. When correctly mounted, the slits are off-centered height-wise, slightly above the center of the slit body. See the slit assembly drawing in the appendices section for details, or pictures on this page for reference.

3. Place the new slit plate in the slit body and secure it in position using the slit plate screws. The cone shaped holes in the slit plate are designed to align the slits to the optical system.
4. The slit width has now been changed.



**Fixed Width Slit Plate
Note Orientation for Correct Installation**

IV: SpectraPro-2500i Operation

Section IV-A: Initialization

When power is turned ON to the SpectraPro-2500i, it initializes to a wavelength of 0.0nm for grating number 1. If the power is switched OFF and then ON again to the SpectraPro-2500i, it will re-initialize. Initialization gives the system a reference, or starting position to keep track of wavelength position, grating location, and other parameters. Alternative start-up parameters can be programmed if the factory defaults are not suitable (See Appendix A).

Section IV-B: Operating the SpectraPro-2500i Using a Computer

The Acton Research Corporation SpectraPro Monochromator is controlled from a computer using the Monochromator Control Software supplied using the RS-232 or USB interface.

Control of the SP-2500i Monochromator at the Command Level:

Although it requires more programming on the user's part, the monochromator can also be controlled with direct commands through its USB 1.1 port or RS-232 port. The same command set, listed below, is used for both RS232 and USB.

Commands can be sent as single commands or grouped in strings of commands. All commands are single words (contain no spaces) and all commands in a string are separated by at least one space. Parameters, if needed, precede the command and are separated from the command by at least one space (e.g. 546.7 GOTO).

For RS232 operation, the port set-up is 9600 baud, 8 data bits, 1 stop bit and no parity. A convenient tool for trying out this mode of operation is the program HyperTerminal supplied with the Windows operating system. The USB 1.1 port with the driver supplied also shows up as and is treated like a com port – although a very fast one. All commands or strings of commands must be terminated with a carriage return (0D hex). The monochromator responds to a command when the command has been completed by returning the characters OK followed by carriage return and line feed (hex ASCII sequence 20 6F 6B 0D 0A). The default condition is to echo each character that is sent to the monochromator with the RS-232 interface and to not echo the commands when using the USB interface. When sending a command or string of commands, it is important to wait for the monochromator to complete the processing of that command string before sending another command.

Monochromator Wavelength Movement Commands:

GOTO	Goes to a destination wavelength at maximum motor speed. Accepts destination wavelength in nm as a floating point number with up to 3 digits after the decimal point or whole number wavelength with no decimal point.
<GOTO>	Same as GOTO (For compatibility with software written for previous SpectraPro models.)
NM	Goes to a destination wavelength at constant nm/min rate specified by last NM/MIN command. Accepts destination wavelength in nm as a floating point number with up to 3 digits after the decimal point or whole number wavelength with no decimal point.
<NM>	Same as NM (For compatibility with software written for previous SpectraPro models.)
>NM	Similar to NM except it returns control to user immediately rather than waiting for completion of monochromator wavelength move. Can be used with ?NM or MONO-?DONE below. This command must be terminated with MONO-STOP listed below. NOTE: Use the NM command when communication with the monochromator during the scan is not required.

?NM	Returns present wavelength in nm to 0.01nm resolution with units nm appended. E.G. ?NM 300.00 nm
MONO-?DONE	Used with >NM command to determine if monochromator has reached the destination. Returns 0 if move is not complete, 1 if move is complete.
MONO-STOP	Stops the monochromator wavelength move after use of the >NM command.
NM/MIN	Sets the scan rate in nm/min to 0.01 nm/min resolution with units nm/min
?NM/MIN	Returns present scan rate in nm/min to 0.01 nm/min resolution with units nm/min
Grating Control Commands:	
GRATING	Places specified grating in position to the wavelength of the wavelength on the present grating. Up to nine (9) gratings are allowed on three (3) turrets. This command takes a grating number from 1 - 9. IMPORTANT NOTE: This command assumes that the correct turret is specified by the TURRET command. For example, using grating numbers 1, 4 and 7 will place the first grating on the installed turret into that position and call up the parameters for the grating number specified.
?GRATING	Returns the number of gratings presently being used numbered 1 - 9.
?GRATINGS	Returns the list of installed gratings with position groove density and blaze. The present grating is specified with an arrow.
TURRET	Specifies the presently installed turret or the turret to be installed. E.G. If installing the second turret, issue the command 2 TURRET to insure using the correct parameters.
?TURRET	Returns the correctly installed turret numbered 1 - 3.

The following command is used for grating installation by ARC part #:

INSTALL	Installs new grating parameters into the non-volatile memory of the SpectraPro monochromator. Uses the part # of the grating to specify the parameters. E.G. 1-120-500 5 INSTALL places a 1200 g/mm grating blazed at 500nm into the second grating position on turret #2.
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The following commands are used for grating installation by grating parameters:

SELECT-GRATING	Specifies the grating number to be installed 1 - 9.
G/MM	Specifies groove density of grating to be installed in g/mm. E.G. 1200 G/MM
BLAZE	Specifies the blaze wavelength and units of the grating to be installed with 7 characters of the user's choice. Unlike other commands, this command is issued before the parameters. After the command is issued, the SP-2500i responds with " ". Seven characters are then entered (these may be numbers, letters, spaces or special characters).
UNINSTALL	Used to remove a grating and its parameters from the SP-2500i non-volatile memory.

Diverter Control Commands:

EXIT-MIRROR	Designates the exit diverter mirror to receive the diverter control commands. This command is for SpectraPro monochromators which can accept two diverter mirrors. The SP-2500i monochromators will accept this command but it is not required in these monochromators.
ENT-MIRROR	Designates the entrance diverter mirror to receive the diverter control commands. This command is for SpectraPro monochromators which can accept two diverter mirrors. The SP-2500i monochromators will not accept this command.
FRONT	Moves the designated diverter mirror to position the beam to the front port position.
SIDE	Moves the designated diverter mirror to position the beam to the side port position.
?MIRROR	Returns the position of the designated diverter mirror with the responses “front” and “side” .
?MIR	Returns the position of the designated diverter mirror with the responses 0 for front and 1 for side.

Slit Width Control Commands:

FRONT-EXIT-SLIT	Designates front exit slit to receive slit control commands. NOTE: The designation remains in effect until changed by another slit designator. This command does not have to be repeated until the designated slit is changed.
SIDE-EXIT-SLIT	Designates side exit slit to receive slit control commands.
FRONT-ENT-SLIT	Designates front entrance slit to receive slit control commands.
SIDE-ENT-SLIT	Designates side entrance slit to receive slit control commands.
MICRONS	Sets the slit width for the designated slit in the range of 10 to 3000 microns to 1 micron resolution.
?MICRONS	Returns the slit width setting in microns to the nearest 1 micron.

GRATING CALIBRATION COMMANDS:

INIT-OFFSET	Sets the offset value for the designated grating. Default values are 0 for gratings 1, 4 and 7; 1536000 for gratings 2, 5 and 8; and 3072000 for gratings 3, 6, and 9. The limits on the settings are +/- 2500 for a 1200 g/mm grating. This corresponds to an error of greater than +/- 5nm for a 1200 g/mm grating. The limits are adjusted for grating groove density, e.g. error for a 600 g/mm grating is +/- 5000. The grating density designator used with this command is grating# - 1. E.G. 3072056. 8 INIT-OFFSET for setting offset on grating #9 - 3rd grating on turret #3. NOTE: This command requires a decimal point after the offset value.
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INIT-GADJUST Sets grating adjustment value for the designated grating. Default values are 10000 for all gratings. The limits on the parameter for this command are +/- 1000 for all gratings. The grating designator used with this command is the grating # - 1. E.G. 9993 1 INIT-GADJUST for setting gadjust on the second grating of turret # 1. NOTE: This command is to maintain compatibility with previous SpectraPro applications. For new applications, use the INIT-SP500-GADJUST command below.

MONO-EESTATUS Returns setup and grating calibration parameters for all gratings.

RESTORE FACTORY SETTINGS Returns all parameters including grating calibration parameters to the original factory calibrated settings.
NOTE: This command will overwrite any calibration parameters set by the user.

MONO-RESET Initializes SpectraPro monochromator. Necessary after using INIT-OFFSET, INIT-GADJUST.

HELLO Same as MONO-RESET. Used to maintain compatibility with existing applications.

MODEL Returns model number of SpectraPro monochromator.
E.G. MODEL SP-2558

SERIAL Returns serial number of SpectraPro monochromator. Format is 7 digits with the first 3 digits being the model #. E.G. SERIAL 23060232

The following are the Start-Up parameters and their default values:

Default Values:

TURRET	#1 GRATING	#1 WAVELENGTH
	0.0 nm	SCAN SPEED 100.0 nm/min

INIT-GRATING Selects which of the three gratings on the installed turret the SpectraPro will go to after finding 0.0 nm on the first grating of the installed turret.
E.G. 2 INIT-GRATING selects the second grating as the default. Accepts values 1 - 9.

INIT-WAVELENGTH Sets an initial wavelength for the SpectraPro after initialization.
E.G. 435.84 INIT-WAVELENGTH

INIT-SRATE Sets an initial scan rate for the SpectraPro.
E.G. 500.0 INIT-SRATE

Section IV-C: Focusing and Alignment of Array Detectors

With the array detector properly mounted to the SpectraPro-2500i, use the following procedure to align and focus the array detector to the SpectraPro-2500i optical system. It is assumed that the array detection system is running with SpectraSense or WinSpec.

1. Mount a light source such as a mercury pen-ray type to the entrance slit of the SpectraPro-2500i. ARC offers a standard mercury lamp, Model MS-416, designed for this purpose. Any light source with line output can be used. If there are no “line” sources available, it is possible to use a broad band source such as tungsten for the alignment. If this is the case, use only a wavelength setting of 0.0nm for alignment purposes.
2. With the SP-2500i properly connected to the controller or computer, turn the power ON and move the spectrograph to a wavelength of 435.8 nm if using a mercury lamp, or 0.0 nm for a broad band source, or another wavelength corresponding to a spectrum produced by another “line” source.
3. With the array detector operating, check the image of the light source if running in an imaging mode with a CCD. Otherwise check the line intensity and shape.
4. Using a 1/8” allen wrench, loosen the two (2) #10-32 set screws (approximately 2 turns) located on the top and side of the front plate, and slowly slide the array detector IN or OUT until the sharpest image is achieved, or the sharpest line is achieved.

CAUTION: The set screws must be loose when turning the thumb wheel adjustment, or severe damage will occur. The distance between the edge of the array detector mounting flange and the instrument **MUST NOT** exceed .33”.

5. Move the thumb wheel until it just makes contact with the array detector mounting flange. This enables you to rotate the detector without changing the focus position. Rotate the detector for correct alignment. The thumb wheel adjustments may be used to precisely position the detector - one eighth of a turn of the thumb wheel changes the detector position by approximately 1/10th of a millimeter.
6. After each adjustment, ensure the array detector mounting flange is in contact with the thumb wheel and the two (2) push screws. Tighten the #10-32 set screw on the top of the front plate first, and then tighten the one on the side to secure the detector.
7. Best spectral resolution is obtained when the array detector is aligned to the SpectraPro-2500i. The light source can be removed if desired, and replaced by fiber optics or other light sources.
8. If fibers or other imaging optics are used to bring light into the SpectraPro-2500i, they may require adjustment along the optical axis to achieve best vertical image quality.

Section IV-D: Converting the SpectraPro-2500i from Monochromator to Spectrograph, or Spectrograph to Monochromator

Monochromator to Spectrograph: This procedure requires that you have the monochromator version, Model SP-2555, plus the array detector mounting flange.

1. Loosen the two (2) set screws.
2. Remove the four (4) 8-32 socket head cap screws (SHCS) which secure the exit slit to the SpectraPro-2500i housing. Details of the slit assemblies can be found in the drawing located in the Appendices Section.
3. Gently slide the slit assembly out of the SpectraPro-2500i housing and store in a clean, dry area. The exit slit assemblies are attached to a sliding tube which is removed along with the slit body.
4. Slide the array detector mounting flange into the SpectraPro-2500i housing so that it rests against the housing. It may be necessary to turn the focus-stop thumb wheel counter clockwise so that it does not interfere with the array detector mounting flange.
5. The SpectraPro-2500i has now been converted from monochromator to spectrograph.
6. Refer to Sections III-E “Mounting Focal Plane Detectors...”, and IV-D “Focus and Aligning Array Detectors” for actual mounting, alignment, and focus of array detectors.

Spectrograph to Monochromator : This procedure requires that you have the spectrograph version, Model SP-2556, plus the Model SP-716-2 exit slit assembly.

1. Loosen the two (2) set screws and gently slide the array detector mounting flange out of the SpectraPro-2500i housing.
2. Remove the array detector if attached, then store the array detector mounting flange in a clean, dry place.
3. Locate the Model SP-716-2 exit slit assembly, then gently slide it into the SpectraPro-2500i housing until it rests against the housing. Exit slit assemblies are attached to a sliding tube to fit the SpectraPro-2500i housing.
4. Using four (4) 8-32 socket head cap screws (SHCS), secure the slit assembly against the SpectraPro-2500i housing. There are four (4) tapped holes in the SpectraPro-2500i housing to facilitate mounting the exit slit.

Note: The slit aperture is slightly offset in the slit assembly. It should be oriented so that the aperture is on the upper side when properly mounted to the SpectraPro-2500i. On the bilateral slits, the micrometer points upward. On the fixed slit assemblies you should be able to read the slit width marking (it will be upright). Please refer to the drawing in the appendices section of this manual for correct orientation if necessary.

5. The SpectraPro-2500i has now been converted from spectrograph to monochromator .

V. Appendices and Schematic Drawings

Appendix V-A: Selecting Alternate Start-Up Parameters

The following are the Start-Up parameters and their default values:

GRATING	# 1
WAVELENGTH	0.0 nm
SCAN SPEED	100.0 nm/min

Each of the above may be changed through the RS232 port or USB port using the following commands. These values are stored in non-volatile memory and will be in effect after the next power-up.

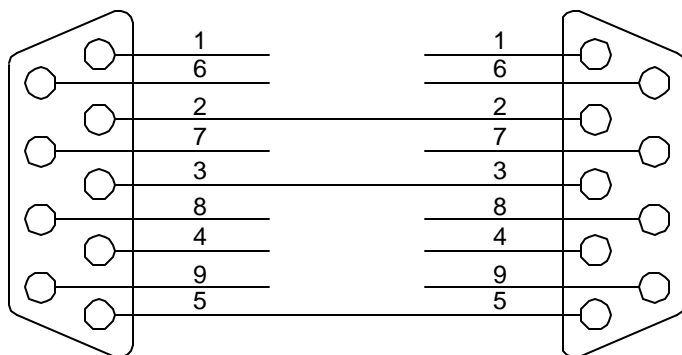
- INIT-GRATING** Selects which of the two gratings on the installed turret the SpectraPro-2500i will go to after finding 0.0 nm on the first grating.
E.G. 2 **INIT-GRATING** selects the second grating as the default
- INIT-WAVELENGTH** Sets an initial wavelength for the SpectraPro-2500i after initialization.
E.G. 435.84 **INIT-WAVELENGTH** Notice that two digits after the decimal point are required
- INIT-SRATE** Sets an initial scan rate for the SpectraPro-2500i.
E.G. 500.00 **INIT-SRATE** Notice that two digits after the decimal point are required

The following command is used to return all grating parameters and start-up parameters to the original factory settings.

Note that any gratings installed at a later date (after initially receiving the SpectraPro-2500i) will be erased from memory using this "restore command".

RESTORE-FACTORY-SETTINGS Returns all parameters, including grating calibration parameters, to the original factory calibrated settings. **NOTE:** This command will overwrite any calibration parameters set by the user.

Appendix V-B: Cable Connection Diagrams - SpectraPro Monochromators & Spectrographs To Computer



**SpectraPro to
PC-AT or Compatible**

DB9P MALE
Mono In

PC
In

Cable Connections (Back Panel):



POWER Power connection +5 and +24 Volts

USB HUB USB Hub 1.1 compatible.

USB USB connection to computer.

RS-232 RS-232 connection to computer.

READY Ready light is on when the instrument is ready to operate. (Green light comes on after the instrument initializes. Yellow = busy)

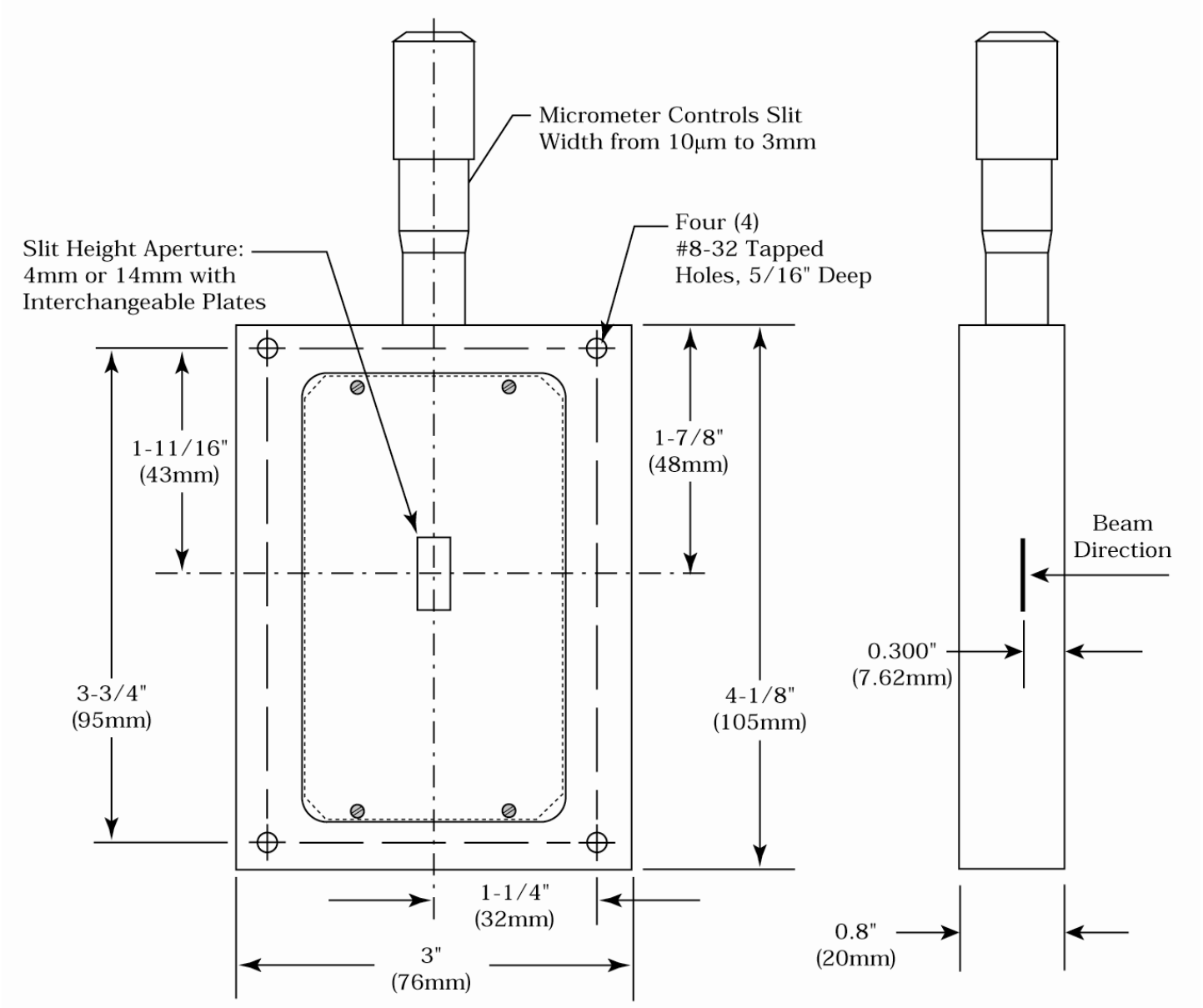
COM Com light flashes when communicating with the computer.

DSP DSP connection to connect two monochromators as doubles.

SHT TTL SHT TTL connection for TTL control of shutter.

FILTER Filter driver connection for ARC FA-448 Filter Wheel.

Appendix V-C: Standard Slit Assemblies



Appendix V-D: Accessories Listing

SpectraPro-2500i Monochromators & Spectrographs

- SP-2555 SpectraPro-2500i: 500mm Monochromator:** Base instrument with 90° optical path, direct digital wavelength drive, built-in RS232 and USB computer compatibility and triple indexable grating mount with one triple grating turret. Requires grating(s), entrance slit, exit slit, and a #500-749 remote scan controller or computer for operation. Includes PC-based monochromator control software for control of SpectraPro-2500i.
- SP-2556 SpectraPro-2500i: 500mm Spectrograph:** Same as above, with an array detector mounting flange mounted on the exit port, compatible with standard Roper Scientific array detectors.
- SP-2557 SpectraPro-2500i: 500mm Dual Exit Port Monochromator:** Same as SP-2555, with a micrometer controlled entrance slit, two micrometer controlled exit slits and a motorized exit slit selection mirror. Provides 90° and 180° optical paths.
- SP-2558 SpectraPro-2500i: 500mm Monochromator/SpectroGraph:** Same as SP-2555, with micrometer controlled entrance and exit slits 180° apart, motorized exit port selection mirror and a multichannel detector adapter flange on end port.

Remote Scan Controller

- 500-749 Remote Scan Controller with Software:** Functions include scanning, change of scan speeds, wavelength readout in nanometers, GOTO, and grating selection. Includes controller (H-P Graphics Calculator with RS232 output port), 5 foot long connecting cable and dedicated scan control software.

Assemblies: Bilaterally Adjustable and Fixed Width

- SP-716-1 Bilaterally adjustable ENTRANCE slit assembly** for SpectraPro-2500i monochromator or spectrograph. Micrometer adjustable widths from 10µm to 3mm. Supplied with interchangeable 4.0mm and 14.0mm high baffles.
- SP-716-2 Bilaterally adjustable EXIT slit assembly** with adapter for SpectraPro-2500i monochromator. Micrometer adjustable widths from 10µm to 3mm. Supplied with interchangeable 4.0mm and 14.0mm high baffles.

Triple Grating Turret

- GT-483 Optional interchangeable triple grating turret** for the SP-2500i. Must be specified at time of SpectraPro manufacture. Includes second turret, requires gratings.

Other SpectraPro Monochromators & Spectrographs

- SP-2155** **SpectraPro-2150, 150mm Monochromator** with internal image correction with original polished aspheric optics, interchangeable dual grating turret, exclusive SpectraDrive™ stepping motor scanning system with 32-bit microprocessor control, RS232 and USB computer interfaces, micrometer controlled entrance and exit slits, 90° optical path and scan control software for Windows. Gratings are required for operation.
- SP-2156** **SpectraPro-2150 150mm Spectrograph:** Same as above with a standard multichannel detector adapter flange on exit port. Provides a 90° optical path.
- SP-2355** **SpectraPro-2300, 300mm Monochromator** with micrometer adjustable entrance/exit slits, 90° optical path, internal image correction with original polished aspheric optics, a triple grating turret, exclusive SpectraDrive™ stepping motor scanning system with 32-bit microprocessor control, RS232 and USB computer interfaces, plus scan control software for Windows. Computer with RS232 or USB and gratings are required for operation.
- SP-2356** **SpectraPro-2300, 300mm Spectrograph:** Same as above Model SP-2355, except with micrometer controlled entrance slit, 14mm X 27mm focal plane, sliding tube CCD adapter with exclusive focus stop and standard multichannel detector adapter flange. Provides a 90° optical path.
- SP-2357** **SpectraPro-2300, 300mm Dual Exit Port Monochromator:** Same as SP-2355, except with micrometer controlled entrance slit, two micrometer controlled exit slits and a motorized exit port selection mirror. Provides 90° and 180° optical paths.
- SP-2358** **SpectraPro-2300, 300mm Monochromator/Spectrograph:** Same as SP-2355, except with micrometer controlled entrance and exit slits 180° apart, motorized port selection mirror and multichannel detector adapter on 90° port.
- SP-2555** **SpectraPro-2500i: 500mm Monochromator:** Base instrument with 90° optical path, direct digital wavelength drive, built-in RS232 and USB computer compatibility and triple indexable grating mount with one triple grating turret. Requires grating(s), entrance slit, exit slit, and a #500-749 remote scan controller or computer for operation. Includes PC-based software for control of SpectraPro-2500i.
- SP-2556** **SpectraPro-2500i: 500mm Spectrograph:** Same as above, with an array detector mounting flange mounted on the exit port, compatible with standard Princeton Instruments, EG&G PARC, or Photometrics (Spectra 9000 type) array detectors.
- SP-2557** **SpectraPro-2500i: 500mm Dual Exit Port Monochromator:** Same as SP-2555, with a micrometer controlled entrance slit, two micrometer controlled exit slits and a motorized exit slit selection mirror. Provides 90° and 180° optical paths.
- SP-2558** **SpectraPro-2500i: 500mm Monochromator/SpectroGraph:** Same as SP-2555, with micrometer controlled entrance and exit slits 180° apart, motorized exit port selection mirror and a multichannel detector adapter flange on end port.
- SP-2755** **SpectraPro-2750, 750mm Monochromator** with a triple indexable grating turret, micrometer controlled entrance and exit slits 180° apart, exclusive SpectraDrive™ stepping motor scanning system, remote scan controller with RS232 computer interface and USB, plus scan control software for Windows. Gratings are required for operation.
- SP-2756** **SpectraPro-2750, 750mm Spectrograph:** Same as above, with micrometer controlled entrance slit and standard multichannel detector adapter flange on exit port. Provides a 90° optical path.
- SP-2757** **SpectraPro-2750, 750mm Dual Exit Port Monochromator:** Same as SP-2755, with micrometer controlled entrance slit, two micrometer controlled exit slits and a motorized exit slit selection mirror. Provides a 90° and 180° optical path.

SP-2758 SpectraPro-2750, 750mm Monochromator/Spectrograph: Same as SP-2755, with micrometer controlled entrance and exit slits 180° apart, exit port selection mirror and a multichannel detector adapter flange on end port.

Light Sources

MS-416 Low Pressure Mercury Light Source with power supply and mounting flange for SpectraPro monochromators and spectrographs. Provides output at typical mercury wavelengths (line output).

DS-421 30 Watt Deuterium Light Source with housing, power supply, mounting flange, and light collection mirror. Provides output from 190 to 350nm.

TS-425 30 Watt Tungsten-Halogen Light Source with housing, power supply, mounting flange, and light collection mirror. Provides output from 350nm to >2.0µm

TS-428 250 Watt Tungsten-Halogen Light Source with housing, AC power supply, mounting flange, variable brightness control and light collection mirror. Provides output from 350nm to >2.0µm.

TS-428-DC Same as TS-428 with Regulated DC Power Supply .

TDS-429 Dual Light Source with 30 watt deuterium & 30 watt tungsten-halogen lamps. Includes housing with light collection mirror, mounting flange, and power supply. Provides combined output from 190 to >2.0µm.

XS-432 75 Watt Xenon Light Source includes power supply, housing, mounting flange and light collection mirror. Provides continuous spectral output from 190nm to 750nm and declining continuum out to 2.6µm. Not available for shipping to Europe.

IS-434 Infrared Source for wavelength region 2.6-16 microns includes silicon carbide resistor, housing, mounting flange, light collection mirror and power supply.

Detectors and Accessories

PD-438 Universal Photomultiplier Tube Housing for standard 1 1/8" side window photomultiplier tubes. Requires side window PMT, and photometer/power supply for operation. Accepts ARC tubes P1, P2 or P3 below, or customer specified 1 1/8" side window PMTs.

PD-439 Same as PD-438 above, also includes integrated **light tight shutter**.

P1 IP28 side window photomultiplier tube (or equivalent) for wavelength region 185-650nm. Fits PD-438 or PD-439 housing.

P2 R928 side window photomultiplier tube (or equivalent) for wavelength region from 185-900nm. Fits PD-438 or PD-439 housing.

P3 R5108 side window photomultiplier tube (or equivalent) for wavelength region from 300-1100nm. Fits PD-438 or PD-439 housing.

ID-441 InGaAs Detector, includes pre-amplifier, uncooled version.

ID-441-C InGaAs Detector, includes pre-amplifier, cooled version, requires either Model 442-1 or 442-1A thermoelectric cooling for operation.

ID-442 Infrared Detection Assembly (PbS) with housing, power supply, and mounting flange for SpectraPro-2500i, for wavelength region from 1.1 - 2.9 microns. (Requires 442-2 preamplifier or customer supplied pre-amplifier for operation). Also requires customer supplied chopper and lockin.

442-1 A Thermoelectric cooling for ID-441 or ID-442 detectors.

442-2 Preamplifier for ID-442 detection assembly.

- ID-443** **IR Detection Assembly (InSb)** for 1.5 to 5.0 microns. Includes detector housing, pre-amplifier, and dewar. Also requires customer supplied chopper and lockin.
- ID-444** **MCT IR Detector** (Mercury Cadmium Telluride). Covers 2 - 15 μm , includes power supply, LN2 dewar and pre-amplifier.
- SpectraHub** **SpectraHub data acquisition system**, 20-bit A-D converter, single channel detector interface, complete with SpectraSense software.

Filter Wheels and Order Sorting Filter Assemblies

- FA-448** **Six Position Filter Wheel Assembly.** Manual sample indexing, holds up to six samples, each 1.0" diameter.
- FA-448-1** **Order Sorting Filter Assembly.** Includes 320nm, 590nm, 665nm, and 715nm filters mounted in FA-448 filter wheel. Manual indexing of filters for elimination of unwanted second order radiation.
- FA-448-2** **Motorized Six Position Filter Wheel Assembly,** with stepping motor and FA-448-4 controller. Enables indexing by computer with RS232 or USB. Requires computer with RS232 or USB for computerized operation.
- FA-448-3** **Motorized Order Sorting Filter Assembly.** Includes 320nm, 590nm, 665nm, and 715nm filters mounted in FA-448-2 filter wheel. Enables computer controlled indexing of order sorting filters for elimination of unwanted second order radiation. Requires computer with RS232 or USB for operation.
- FA-448-5** **Controller Only** for FA-448 or 448-1 filter wheel assemblies. Retrofit kit which enables changing the FA-448 or 448-1 from manual to computer controlled indexing. Requires FA-448

Fiber Optic Light Guides: All Fiber optic light guides contain 19 fibers, 200 μm diameter, arranged in a line pattern at the slit end, and round at the source end.

- LG-455-020-1 UV-VIS Fiber Optic Bundle** 1.0 meter long, for 190nm to 1100nm. Requires mount.
- LG-455-020-3 UV-VIS Fiber Optic Bundle** 3.0 meter long, for 190nm to 1100nm. Requires mount.
- LG-456-020-1 VIS-NIR Fiber Optic Bundle** 1.0 meter long, for 400nm to 2200nm. Requires mount.
- LG-456-020-1 VIS-NIR Fiber Optic Bundle** 3.0 meter long, for 400nm to 2200nm. Requires mount.
- FC-446-020 Slit mount** with horizontal translation capability for 10mm diameter fiber optic bundle.

Connecting Cables

- CC-499-2** Cable for IBM-PC AT or compatible computer. 9 pin **female** connector to 9 pin **male** connector.
- 3650-USB-06** USB cable. Type A to B

Gratings for SpectraPro-2500i

Grooves/mm	Blaze Wavelength	Part Number
20	45µm	1-002-45
75	8µm	1-075-8
50	12µm	1-050-12
150	500nm	1-015-500
150	4µm	1-015-4
300	300nm	1-030-300
300	500nm	1-030-500
300	2µm	1-030-2
600	300nm	1-060-300
600	1µm	1-060-1
600	1.6µm	1-060-1.6
1200	300nm	1-120-300
1200	500nm	1-120-500
1200	750nm	1-120-750
1200	holographic†	1-120-HUV
1200	holographic††	1-120-HVIS
1800	250nm	1-180-250
1800	500nm	1-180-500
2400	240nm	1-240-240
2400	holographic†††	1-240-H
3600	240nm	1-360-240

NOTES:

† Blazed Holographic, 190-400nm optimum range

†† Blazed Holographic, 450-1400nm optimum range

††† Blazed Holographic, 190-400nm optimum range

Gold coated optics are available on request.

Ordering Information

Telephone Orders

Telephone orders may be placed between 7:30AM and 5:00PM EST. Written "Confirmations" are required on all verbal orders.

Telephone: (978) 263-3584

Fax Orders

Orders may be placed by fax with written confirmation. Please include complete name and address with these orders

FAX: (978) 263-5086

MasterCard / VISA

MasterCard & VISA accepted for purchases.

Written Orders

Submit all written orders to our mailing address:

Acton Research Corporation

15 Discovery Way
Acton, MA 01720 U.S.A.

Orders accepted subject to current pricing.
All orders FOB Acton or shipping charges & insurance added separately.

• SpectraPro® is a registered trademark of Acton Research Corporation •

Appendix V-E: Certification and Warranty

Certification

Acton Research Corporation (ARC) certifies that this instrument was thoroughly tested and inspected and found to meet the specifications furnished by ARC when it was shipped from the factory.

Warranty

Acton Research Corporation (ARC) instruments and accessories are warranted for a period of one full year from date of delivery to be free from defects in material and and to conform to the specifications furnished by ARC. The corporation's obligation under this warranty is limited to servicing or adjusting an instrument returned to the factory, prepaid, and to repairing or replacing at the factory any part or parts thereof. All purchased items carry the original manufacturers warranty.

Acton Research Corporation shall not be liable for consequential damages resulting from accident, alteration, misuse, improper installation, operation on low or excessive voltages or any use in violation of the operating instructions furnished by ARC.

If any defect appears within the warranty period, the purchaser shall promptly notify ARC. No material will be accepted for repair or replacement without prior authorization from ARC. Upon such authorization and in accordance with instructions of Acton Research Corporation, parts, materials or equipment for which repair or replacement is requested shall be returned to ARC for examination, with shipping charges prepaid by the purchaser. Final determination as to whether a product or part is actually defective rests with Acton Research Corporation.

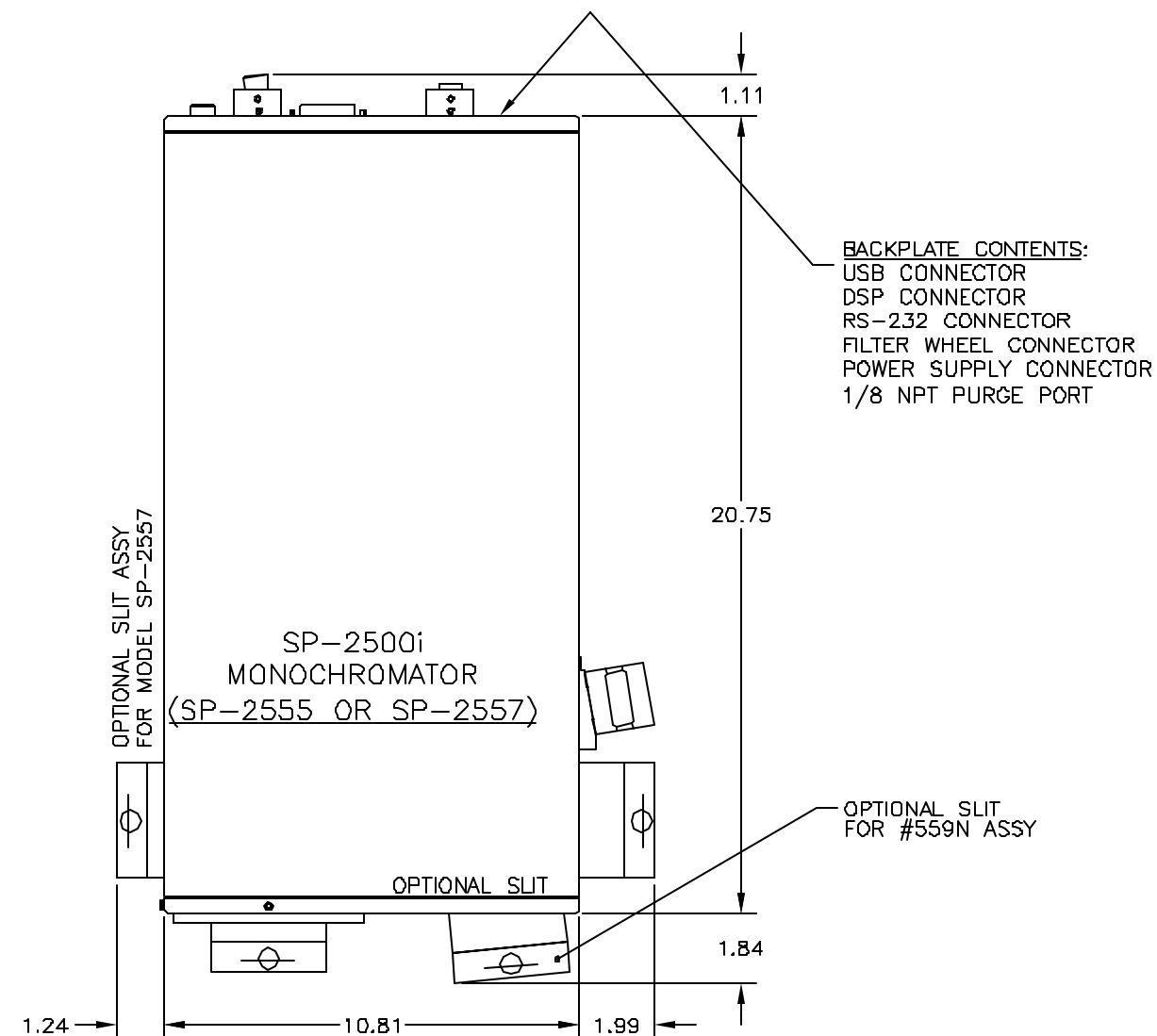
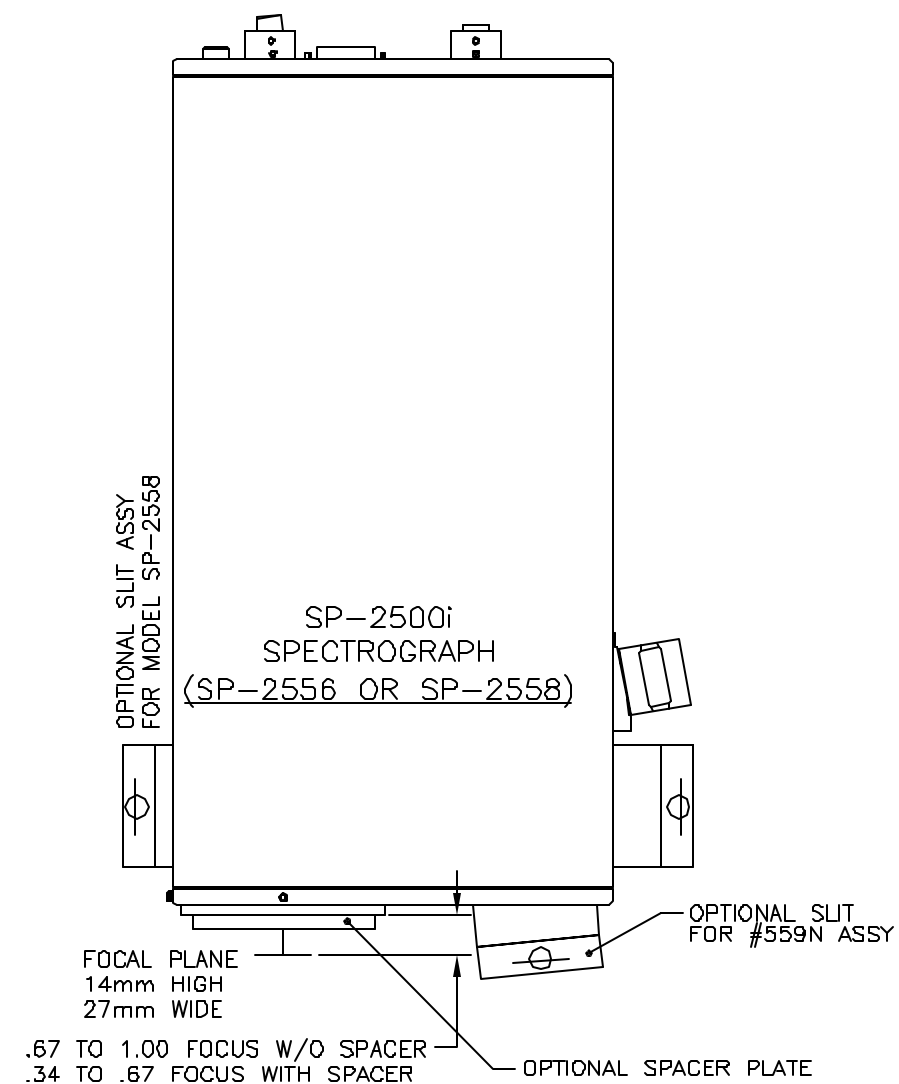
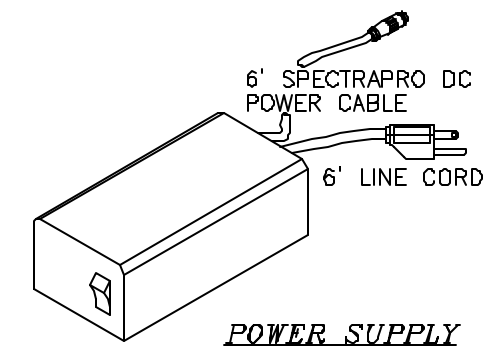
In such cases where necessary repairs are not covered by this warranty, an estimate of repair charges will be submitted to the purchaser before servicing the equipment.

Acton Research Corporation reserves the right to make changes or improvements upon its products without imposing any obligations upon itself to install the same upon its products previously manufactured.

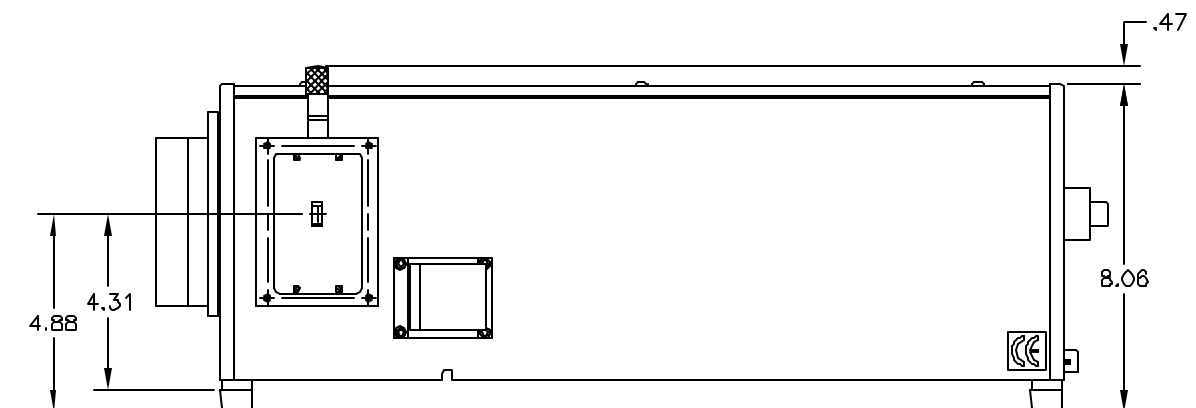
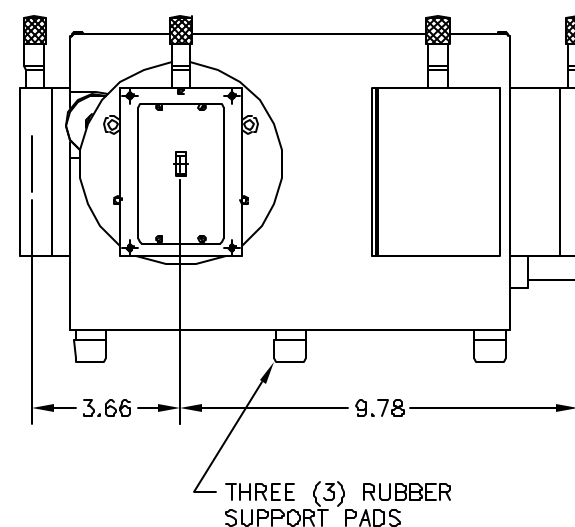
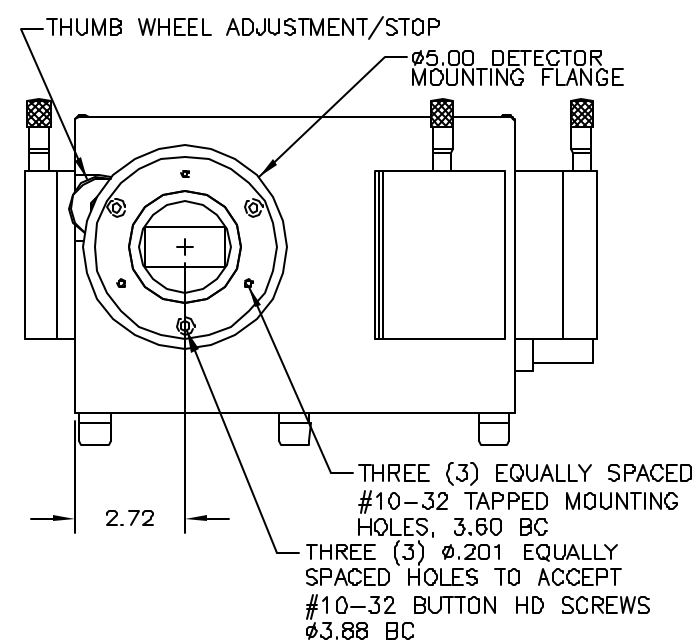
This warranty is expressly in lieu of all other obligations or liabilities on the part of ARC, and ARC neither assumes, nor authorizes any other person to assume for them, other obligations or liability in connection with the sale of equipment manufactured by Acton Research Corporation.

Appendix V-F: Drawings

THIS DRAWING REMAINS THE PROPERTY OF ACTON RESEARCH CORPORATION AND CONTAINS PROPRIETARY INFORMATION WHICH SHALL NOT BE REPRODUCED OR DISCLOSED WITHOUT WRITTEN AUTHORIZATION




APPROXIMATE WEIGHT: 40 LBS (18.2 Kg)



SCALE: NONE	DIMENSIONS ARE IN INCHES	DRAWN BY: HCL
DATE: 5-21-03		QTY: 1
ACTON RESEARCH CORPORATION		15 DISCOVERY WAY ACTON, MA 01720
DWG. TITLE SPECTRAPRO 2500i	DWG NO. 8450-600-50	REV. 0

REV	DESCRIPTION	DATE
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UNLESS OTHERWISE SPECIFIED		MATERIAL		FINISH	
DIMENSIONS ARE IN INCHES TOLERANCE ON FRACTIONS DECIMALS ANGLES $\pm 1/64$ $.XX \pm .010$ $\pm 15 \text{ MIN}$ $.XXX \pm .005$ MACHINE SURFACE $32\sqrt{\text{MAX}}$ REMOVE ALL BURRS & BREAK SHARP EDGES $R.010 \text{ MAX}$		SCALE: NTS		DRAWN BY: HCL	
		DATE: 05-21-03		NEXT ASS'Y:	
		 ACTON RESEARCH CORPORATION		BOX 2215/525 MAIN ST. ACTON, MA 01720	
DWG. TITLE		SIZE	DWG NO.		REV.
SP-2500i SUPPORTS		B	8450-600-51		0